THERMOSTATIC TEMPERATURE CONTROL FOR SHIPMENTS OF EARLY-SEASON BARTLETT PEARS

AMS-476

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Market Quality Research Division

PREFACE

Although Bartlett pears harvested in mid-July from the earliest California production areas meet maturity requirements, they are firmer when harvested and require a longer ripening period than those shipped later in the season. If these pears are shipped under maximum refrigeration, 7 to 10 days elapse after they reach the market before they are ripe enough for the retail market. During this delay additional shipments of pears are arriving at the market daily. This accumulation of supplies depresses the market, sometimes permanently. A remedy is to initiate the ripening process during transit so that the pears ripen within 2 or 3 days of unloading and are marketed in an orderly manner. This has two advantages: Quality of the fruit is better, because the controlled transit temperature is more favorable for ripening than that prevailing at the market in July, and oversupplies during this early part of the season are avoided.

Many tests have been made to find the most satisfactory and least expensive way of providing the proper temperatures for early-season Bartlett pears during shipping. Modified icing schedules were developed in earlier tests to provide temperatures favorable to the initiation of ripening of early pears.

Thermostatic control of temperatures during transit was tested in 1961. One purpose of these tests was to find out what setting of the thermostat was best for early-season pears, depending upon their firmness and temperature at the time of loading. The time required to ripen fruit shipped at different thermostat settings was also studied.

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SUMMARY

Thermostatic control of temperature in rail shipments of early-season Bartlett pears offers a means of initiating ripening in transit and controlling the time required to bring the fruit to a salable condition at the market. This report gives the results of shipping pears in Ice Tempco[2] cars, which use ice as a refrigerant and have thermostatically controlled fans; in mechanically refrigerated cars; and in conventional ice-bunker cars.

Early fruit with initial firmness near 20 pounds required 2 days after reaching New York for the color to start turning yellow and 4 days to reach an eating-ripe stage, when shipped from California at average temperatures of 60° to 64° F. Unless fruit was unusually warm initially, a thermostat setting of 60° would provide average temperatures in this range in an Ice Tempco car operating properly.

Fruit with initial firmness near 18 to 19 pounds colored in 2-1/2 days and ripened to the eating-ripe stage in slightly over 3 days when shipped to eastern markets at average temperatures of 55° to 59° F. Fruit that was initially below 75° probably would have average transit temperatures close to 55° with a thermostat setting at that temperature in an Ice Tempco car.

For uniform temperatures in all parts of the load Ice Tempco cars should be equipped with a ceiling duct. Wide temperature differences between the bunker end and the end opposite the bunker were found in Ice Tempco cars without a duct.

Some mechanically refrigerated cars also had temperature differences between ends of the car, the end nearest the refrigeration unit being the colder.

Modified icing in conventional fan cars provided satisfactory temperatures for initiating ripening in transit. This service was the most economical way of shipping pears by rail. Fruit that was near 80° F. and near 20 pounds firmness initially colored in about 2-1/2 days and was "eating ripe" in slightly less than 4 days after removal from the car at the market, when shipped in a car that was pre-iced to half-stage capacity, replenished at the first icing station en route, and re-iced at Council Bluffs, Iowa, and Columbus, Ohio. Charges for this service were $31 less than half-stage Standard Refrigeration and $62 less than full-bunker Standard Refrigeration. Refrigeration charges for Ice Tempco cars are the same as for half-stage Standard Refrigeration; those for mechanically refrigerated cars are the same as for full-bunker Standard Refrigeration.

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[2] Use of the name "Ice Tempco" and "Cargotemp" are for identification only and does not constitute special approval or disapproval of these cars in comparison with others of similar design.

BACKGROUND

Thermostatic control of temperature is being used more each year in the transportation of perishable products. The growing fleet of mechanically refrigerated rail cars and the new Ice Tempco cars both provide thermostatic control of temperature. When such equipment is used for shipping early-season Bartlett pears, it is important to know the thermostat setting that will provide sufficient ripening in transit to assure the right amount of time for marketing fruit shipped to eastern markets.

Tests in the 1960 season provided some information on the performance of mechanically refrigerated cars and the experimental Cargotemp car. The Cargotemp car is a two-bunker car, using ice as a refrigerant and providing thermostatic control of the fans. In the 1961 season the Ice Tempco car was offered to the shippers. This car is similar to the Cargotemp, except that one of the bunkers was removed to provide greater load space in the car; the remaining bunker was enlarged slightly, and the fan capacity was increased. Since the single bunker holds about as much ice as a conventional ice car shipped half-stage, the refrigeration charge is the same as that for half-stage Standard Refrigeration.

The Ice Tempco car is equipped with a small diesel engine which drives an alternator to provide power for the fans. There are two sets of fans; one set operates continuously through a bypass channel, which permits circulation of air within the load compartment only. The other set of fans operates on a thermostat and draws air through the ice bunker only when refrigeration is required to cool the load to the thermostat setting.

A single test, in the 1960 season, with a pilot model of this single-bunker car showed considerable temperature variation between the two ends of the load compartment. Temperatures in the "B" end of the car, adjacent to the ice bunker, were lower than those in the "A" end, opposite the bunker. Consequently, in tests made in the 1961 pear season, test packages and recording thermometers were placed in both ends of the cars to determine the extent of temperature variation and the effects of such variation on ripening. Test packages and instruments, placed in the top, middle, and bottom layers of the loads at the quarter-length positions, provided an average temperature in each end of the car.

Loading data, protective services, and routings of test cars shipped in the 1961 season are shown in table 1.

TABLE 1.--Loading data, protective services, and routings of test cars of Bartlett pears shipped from California districts on indicated dates in 1961 season

Test car No.	Date shipped 1961	District of origin	Destination	No. of crates in load	Protective services and equipment	Routing[1]
Pr-1	July 11	Sacramento River	New York	720	Ice Tempco service--55° F. (1 bypass fan)	SP, UP, IC, Penn.
Pr-2	July 12	Sacramento River	New York	720	Ice Tempco service--55° F. (1 bypass fan)	SP, UP, CMStP&P, IHB, Penn.
Pr-3	July 12	Sacramento River	New York	722	Pre-iced, half-stage, replenished, 2 re-icings (Council Bluffs, Iowa, and Huntingdon, Pa.)	SP, UP, IC, Penn.
Pr-4	July 13	Sacramento River	New York	720	Mechanical refrigeration service--55° F.	SP, UP, IC, Penn.
Pr-5	July 13	Sacramento River	New York	704	Ice Tempco service--55° F. (1 bypass fan)	SP, UP, CMStP&P, IHB, Penn.
Pr-6	July 19	Sacramento River	New York	840	Ice Tempco service--50° F. (2 bypass fans)	SP, UP, CMStP&P, EL
Pr-7	July 19	Sacramento River	New York	704	Ice Tempco service--50° F. ("B"-end floor racks covered with paper, 1 bypass fan)	SP, UP, CMStP&P, IHB, Penn.
Pr-8	July 20	Sacramento River	Toronto (car diverted from New York)	720	Pre-iced, half-stage, standard refrigeration	SP, UP, CMStP&P, IHB
Pr-9	July 20	Sacramento River	New York	826	Mechanical refrigeration service--50° F.	SP, UP, CMStP&P, IHB, EL
Pr-10	Aug. 15	Mendocino County	Chicago	840	Ice Tempco service--34° F. (ceiling duct, 2 bypass fans)	NWP, SP, UP, CMStP&P
Pr-11	Aug. 16	Lake County	New York	744	Pre-iced, half-stage, 1 re-icing in transit (Council Bluffs)	NWP, SP, UP, CBQ, TPW, Penn.
Pr-12	Aug. 22	Placerville	New York	798	Ice Tempco service--35° F. (ceiling duct, 1 bypass fan)	SP, UP, C&NW, EL
Pr-13	Aug. 23	Placerville	New York	798	Ice Tempco service--35° F. 3 percent initial salt. (ceiling duct, 1 bypass fan)	SP, UP, IC, Penn.

[1] Rail lines abbreviated in accordance with the Official Railway Guide, National Railway Publication Co., New York

TEMPERATURE AND RIPENING OF FRUIT DURING TRANSIT

Pears Shipped in Ice Tempco Cars

The first test (Pr-1) of the 1961 season was made on July 11 with fruit shipped from Walnut Grove, Calif. (fig. 1). The thermostat in the car was set at 55° F., which was considered desirable for fruit with initial pressures near 20 pounds.

The initial temperature of the fruit was near 80° F., and there was a gradual drop in temperature to a final reading near 40° in the "B" end (adjacent to bunker) and between 45° and 48° in the "A" end of the car. Obviously, the thermostat did not function in this car, and consequently the temperatures were well below the thermostat setting for a considerable part of the trip. The temperature dropped very rapidly in the "B" end of the car, reaching the thermostat setting after about 2 days in transit. In the "A" end, the fruit did not cool to the thermostat setting until about the fourth or fifth day in transit. There were also more variations in temperature among layers in the "A" end than in the "B" end. The top layer cooled more than the bottom or middle layers.

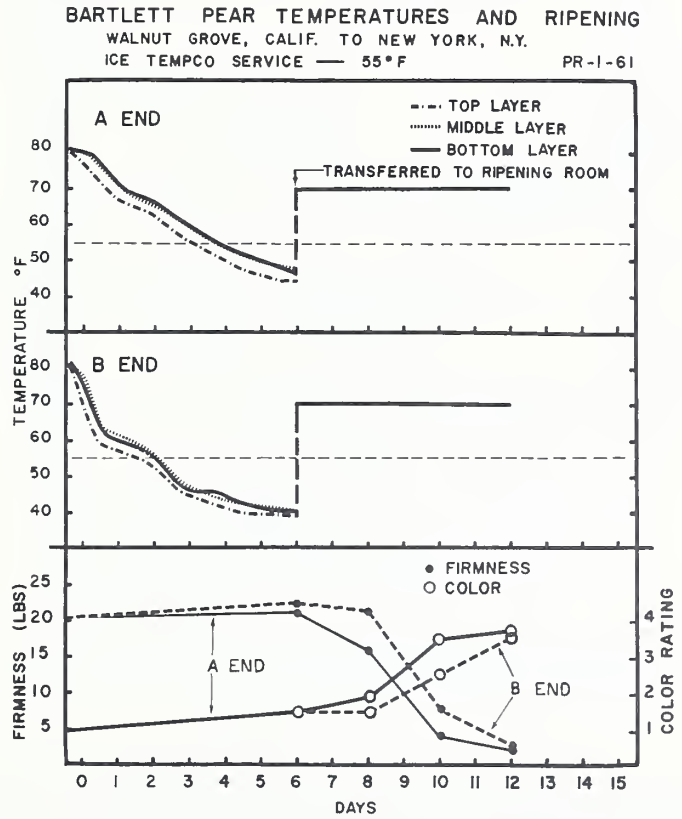

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Figure 1.--Transit temperatures, firmness, and color ratings of early-season Bartlett pears shipped, July 11, 1961, from the Sacramento River District of California to New York, N. Y.

On arrival the fruit was as firm as it was initially, or slightly firmer. Fruit in the "B" end of the car required almost 6 days to reach an eating-ripe stage; fruit in the "A" end took about 5 days.

The color break (3 rating, fig. 1) was reached in about 3-1/2 days in fruit from the "A" end of the car and in about 5 days in fruit from the "B" end.

Another shipment (Pr-2) in an Ice Tempco car was made on July 12 (fig. 2). Here the thermostat functioned properly, and temperatures leveled off near the thermostat setting of 55° F. in the "B" end of the car. Since the thermostat was located in the bypass duct, the air moving through the duct corresponded most closely to temperatures in the "B" end of the car where most of the air was circulating. Temperatures in the "A" end of the car were considerably above the thermostat setting, ranging between 60° and 70° for a considerable part of the trip. There was also considerable variation among layers in the "A" end.

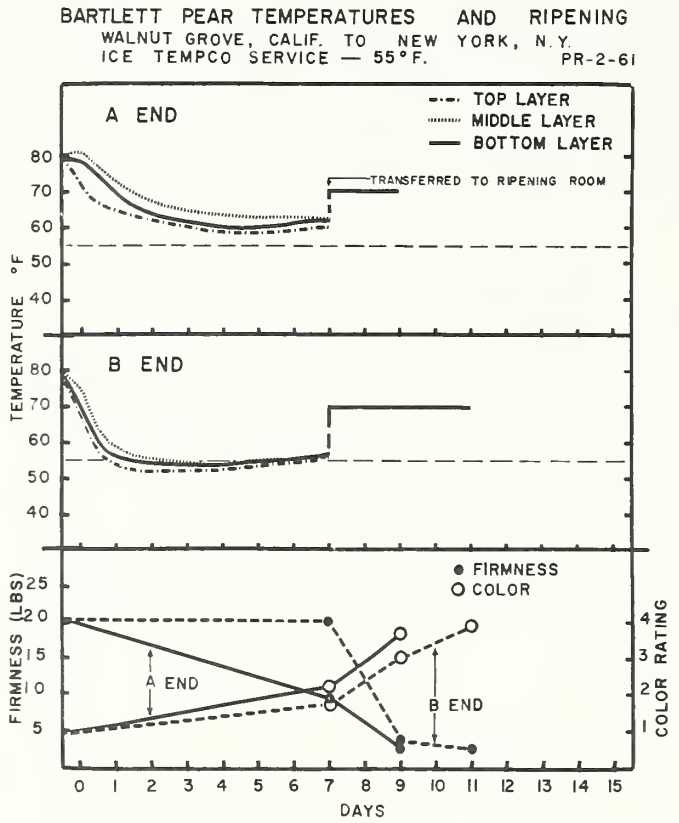

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Figure 2.--Transit temperatures, firmness, and color ratings of early-season Bartlett pears shipped July 12, 1961, from the Sacramento River District of California to New York, N. Y.

The firmness of the fruit on arrival was near the initial 20 pounds in the "B" end of the car, but fruit in the "A" end had softened to slightly below an average of 10 pounds. Fruit in the "B" end required about 3 days to reach an eating-ripe stage, but that in the "A" end was eating-ripe in less than 2 days.

The color break in fruit from the "B" end of the car was reached about 2 days after arrival, and in about 1 day in fruit from the "A" end.

Obviously, the temperatures in the "A" end of the car provided more ripening than was desirable and did not leave sufficient time to market the fruit after it reached New York.

A possible way to improve the uniformity of temperatures in the Ice Tempco car was to lay paper on the floor on the "B" end, forcing the air to the "A" end before it could return to the ice bunker. A test (Pr-7) with a car modified in this way was made

on July 19 with fruit that was slightly above 18 pounds initial firmness (fig. 3). The thermostat was set at 50° F. because of the lower initial firmness of the fruit at this shipping date.

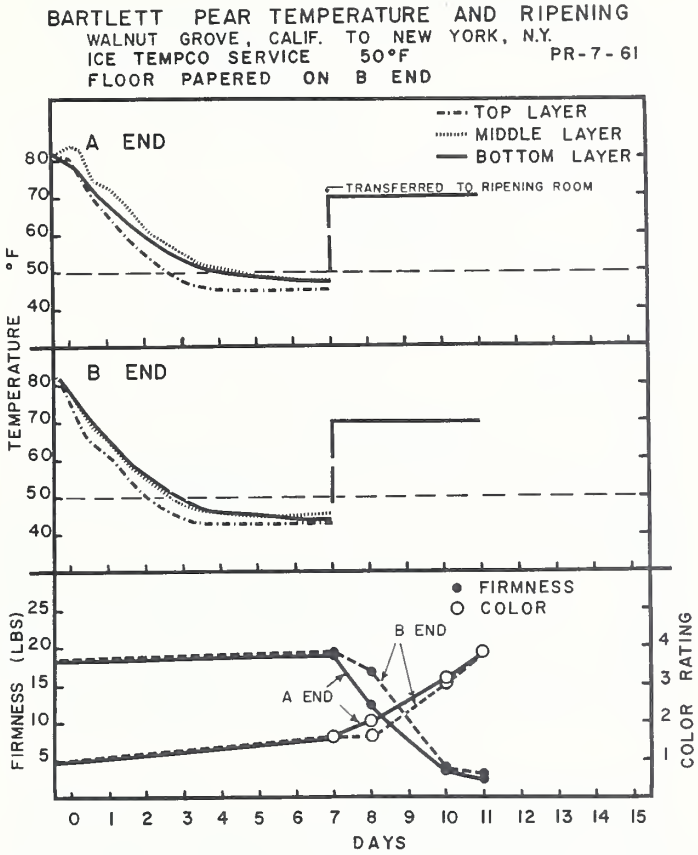

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Figure 3.--Transit temperatures, firmness, and color ratings of early-season Bartlett pears shipped, July 19, 1961, from the Sacramento River District of California to New York, N. Y.

The paper did improve air distribution in the car, but temperatures were still slightly warmer in the "A" end than in the "B" end. There was still a considerable variation in layer temperatures in the "A" end of the car. The thermostat in this car appeared to be somewhat out of calibration, and the temperatures leveled off near 45° F., 5 degrees below the thermostat setting.

The fruit did not soften in transit and was above 18 pounds on arrival. Fruit from the "A" end of the car softened a little more rapidly than fruit from the "B" end, but both reached an eating-ripe atage about 3 days after arrival. The color break was reached 2-1/2 to 3 days after arrival.

The most feasible solution to the problem of nonuniform temperatures in the car appeared to be a ceiling duct to carry the air to the doorway and dump it in the "A" end. A test (Pr-12) with a car equipped with a duct was made with fruit shipped from Placerville on August 22 (fig. 4). The fruit had an initial firmness near 19 pounds. Since the shipper wanted to precool the fruit in the car, the thermostat was set at 35° F. for maximum refrigeration. Temperatures dropped gradually from near 75° initially to a final reading near 40° in both ends of the car. There was a slight lag in cooling the bottom layer of the "A" end, but this could probably be corrected by placing a spacer against the end wall to allow part of the air to pass between the wall and the load, returning through channels in the load and under the floor rack.

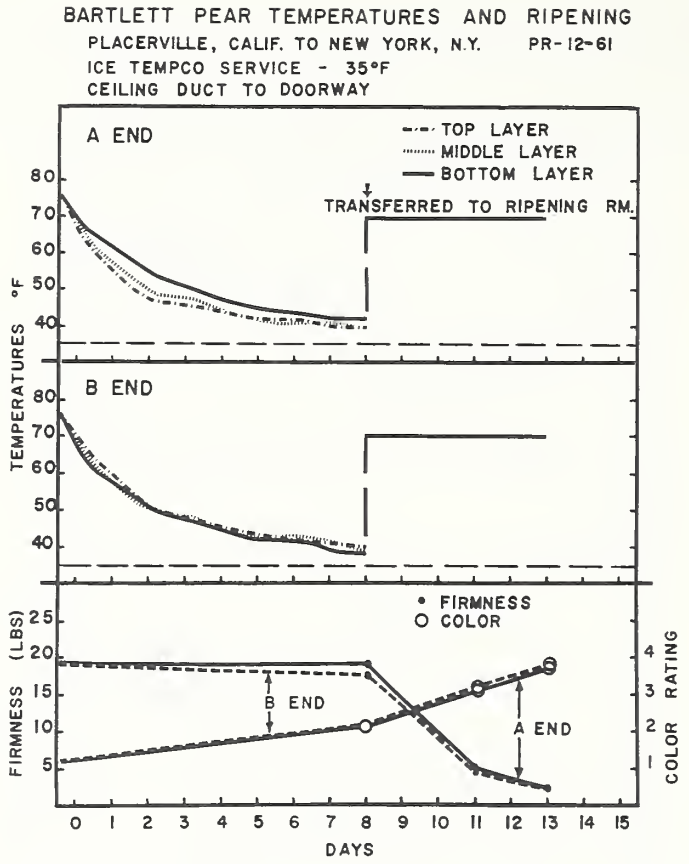

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Figure 4. --Transit temperatures, firmness, and color ratings of mid-season Bartlet pears shipped, August 22, 1961, from the Placerville District of California to New York, N. Y.

Firmness and color were quite uniform in fruit from both ends of the car. On arrival, pressures were above 17 pounds in all test fruit, and about 4 days were required for the fruit to reach an eating-ripe stage. The color break was reached in about 3 days.

The duct improved temperature uniformity in the two ends of the car. Although temperatures did not reach the thermostat setting of 35° F., they were in a safe range and there was no excessive ripening of the fruit.

This car held 7,400 pounds of ice, and the icing records showed that the car never ran completely out of ice. When replenished at Roseville, however, it took 6,800 pounds (table 2).

Results of other tests (Pr-5, Pr-6, Pr-10, and Pr-13) with Ice Tempco cars are given in the Appendix.

TABLE 2.--Icing record for test cars of Bartlett pears shipped from California districts in 1961 season

Test car No.[1]	Days from loading to unloading	Ice added								Estimated ice remaining[4]	Total ice melted	Estimated ice used to refrigerate load[5]
		Before loading; pre-ice and retouch[2]	After loading						Total			
			Re-plenish[3]	Re-ice								
				First	Second	Third	Fourth	Fifth	Sixth			
		Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Pr-1	6-3/4	7,400 1,500 600	7,300	2,000	5,800	3,200	5,800			33,600	5,650	27,950	19,950
Pr-2	7-1/2	7,400	6,300	1,700	2,500	3,700				21,600	5,150	16,450	15,117
Pr-3	6-1/2	6,000 600	5,200	5,200	5,200					22,200	2,400	19,800	15,800
Pr-4	6-3/4	Mechanical refrigeration											
Pr-5	7-1/2	7,400	6,500	1,200	3,200	3,800				22,100	5,150	16,950	15,200
Pr-6	6-3/4	7,400	5,600	4,800	5,200	2,800	1,200	1,600		28,600	4,700	23,900	22,300
Pr-7	6-1/2	7,400	7,200	4,800	5,500	2,600	2,500	4,000		34,000	6,050	27,950	25,950
Pr-8	--	6,000	5,800	3,000	5,400	4,800	3,000			28,000	([6])	([6])	([6])
Pr-9	7-1/4	Mechanical refrigeration											
Pr-10	6	7,400	2,900	3,400	3,600	5,400				22,700	300	22,400	20,982
Pr-11	6-3/4	6,000	--	4,200						10,200	3,150	7,050	6,050
Pr-12	8-1/2	7,400	6,800	5,000	6,500	4,000	1,800	2,200	5,000	38,700	7,175	31,525	29,775
Pr-13[7]	6-3/4	7,400	6,000	2,600	3,600	4,600	4,400			28,600	6,050	22,550	20,050

[1] See table 1 for protective services, loading data, and routing of test cars.
[2] The "retouch" is ice added after the initial pre-icing and before the car is loaded.
[3] The "replenish" is the ice added at the first icing station reached after the car is loaded.
[4] Based on an estimated ice meltage of 75 pounds per inch below hatch opening in each bunker.
[5] Estimate based on calculation of 1 ton ice meltage per day in empty car before loading.
[6] Not available.
[7] 3 percent of salt added at loading, 180 lb. added at replenish, 180 lb. at second re-icing, and 138 lb. at third re-icing.

Pears Shipped in Mechanically Refrigerated Cars

Test shipments also were made in mechanical cars in the 1961 season. Temperature variations in these cars were similar to those in the Ice Tempco cars. In the mechanical cars the compressor and coil are located in the "A" end of the car. The fruit temperatures in a test car (Pr-4) shipped on July 13 were lower in the "A" end than they were in the "B" end, away from the source of refrigeration (fig. 5). The temperatures leveled off about 3 degrees above the thermostat setting in the "A" end, and about 2 to 7 degrees above the thermostat setting in the "B" end. These temperature differences indicated a need for better thermostat calibration and also better air distribution in the car. There was also more temperature variation among layers in the "B" end than in the "A" end.

Fruit firmness was still near 20 pounds in the "A" end of the car on arrival, but fruit in the "B" end was slightly less firm than it had been. Fruit from both ends reached an eating-ripe stage about 3 days after arrival. The color break was reached in about 2 days.

A second test (Pr-9) with a mechanical car was made on July 20. Initial fruit firmness had decreased to the 18- to 19-pound range, and consequently the thermostat was set at 50° F. (fig. 6). Again, the temperatures in the "A" end leveled off slightly above the thermostat setting, but those in the "B" end were 10 to 15 degrees above the thermostat setting for most of the transit period.

Firmness during transit did not change appreciably in fruit in the "A" end of the car, but that in the "B" end softened to an average of about 6-1/2 pounds, which was much too soft to allow sufficient time for marketing. Fruit from the "A" end reached an eating-ripe stage about 2 days after arrival, and that from the "B" end was probably eating-ripe in

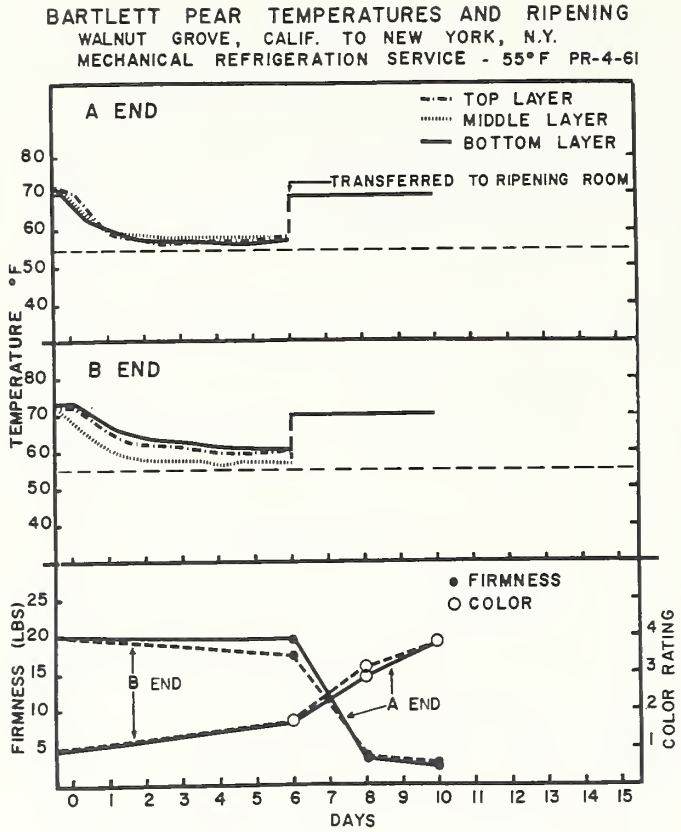

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Figure 5. --Transit temperatures, firmness, and color ratings of early-season Bartlett pears shipped, July 13, 1961, from the Sacramento River District of California to New York, N. Y.

about 1 day. Inspections at the market were at 2-day intervals so it was a little difficult to determine the time required to reach the color break in fruit that ripened this fast; however, fruit in the "A" end apparently reached the color break in about 1-1/2 days, and that in the "B" end in about 1 day.

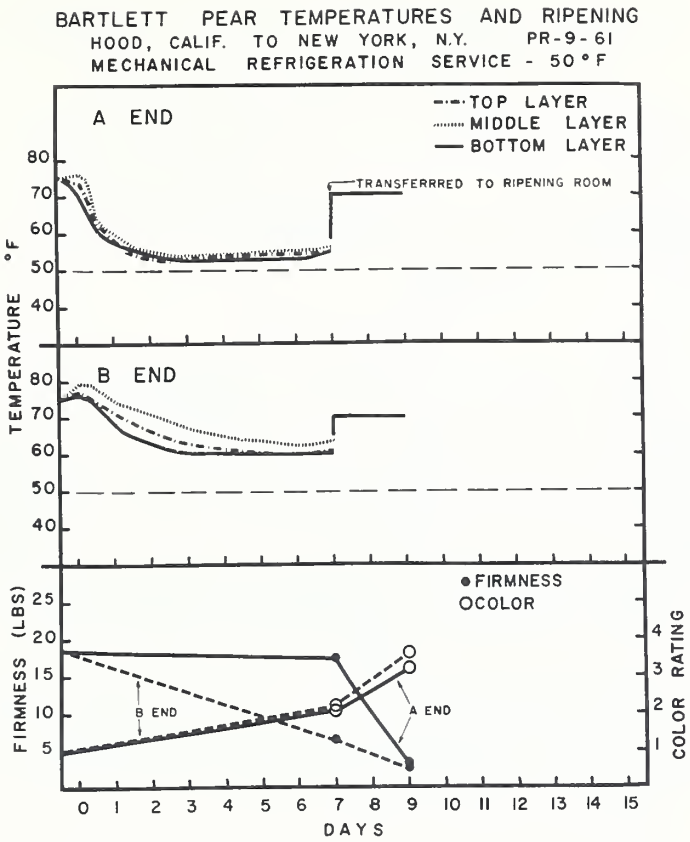

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Figure 6.--Transit temperatures, firmness, and color ratings of mid-season Bartlett pears shipped, July 20, 1961, from the Sacramento River District of California to New York, N. Y.

Pears Shipped in Conventional Cars With Modified Icing

Modified icing practices in conventional cars were re-checked in the 1961 season. A conventional car (Pr-3) that was pre-iced to half-stage capacity, replenished, and re-iced at Council Bluffs, Iowa, and Columbus, Ohio, was shipped on July 12 from Walnut Grove (fig. 7). Fruit temperatures started close to 80° F. and gradually fell to a final temperature of 55°. These transit temperatures were quite satisfactory for early-season fruit. The initial firmness was about 20 pounds; it did not change in transit; and the fruit reached an eating-ripe stage in about 3-1/2 to 4 days. The color break was reached in about 2-1/2 days.

The refrigeration charge for this particular service was $82 in 1961, which saved $31 over half-stage Standard Refrigeration and $62 over full-bunker Standard Refrigeration.

If fruit is precooled before shipment, even greater savings can be made with modified refrigeration. Precooled fruit was shipped from Kelseyville, Calif., on August 16, in a car (Pr-11) that was pre-iced, was not replenished, and had only one re-icing (fig. 8).

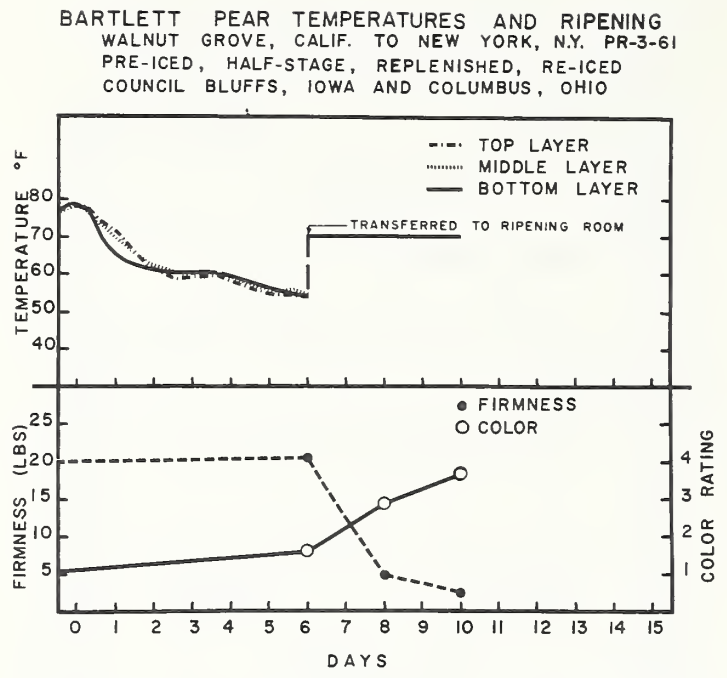

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Figure 7. --Transit temperatures, firmness, and color ratings of early-season Bartlett pears shipped, July 12, 1961, from the Sacramento River District of California to New York, N. Y.

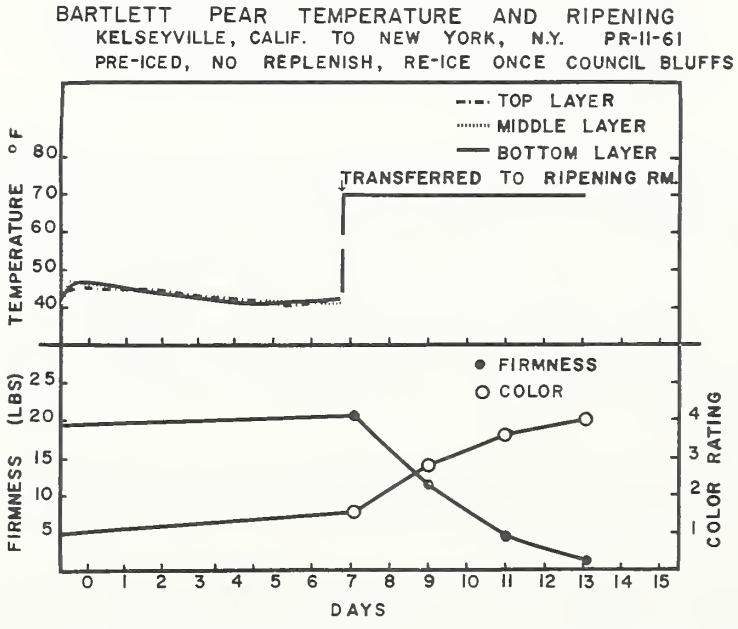

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Figure 8. --Transit temperatures, firmness, and color ratings of mid-season Bartlett pears shipped, August 16, 1961, from the Sacramento River District of California to New York, N. Y.

The fruit had been precooled to about 45° F. and remained between 40° and 45° during the entire transit period.

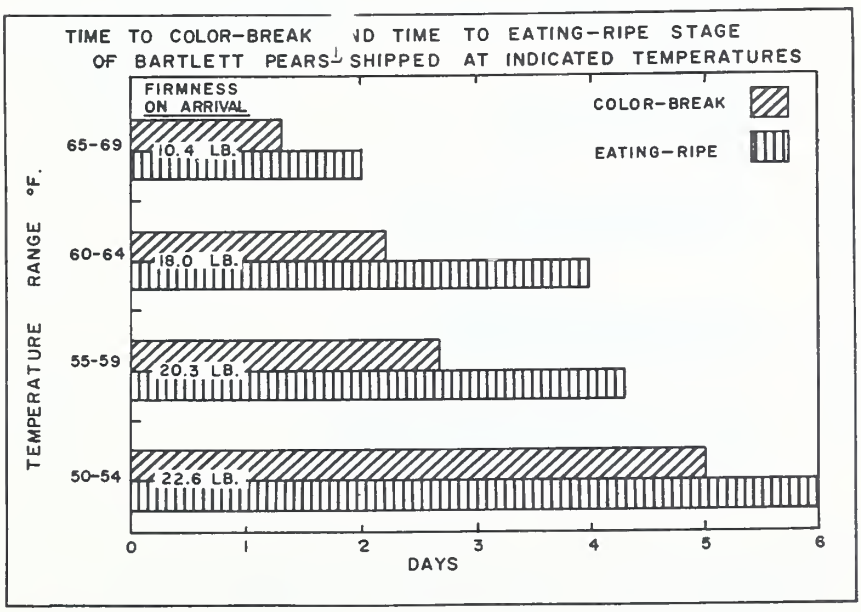
The initial firmness was slightly below 20 pounds, and no softening occurred in transit. The fruit required about 5 days from arrival to reach an eating-ripe stage. The color break was reached in about 2-1/2 days.

The refrigeration charge for this service was $58, which was $55 less than half-stage Standard Refrigeration, and $86 less than full-bunker Standard.

DISCUSSION

The performance of the first Ice Tempco cars, and to some extent the mechanical cars that were tested, was not satisfactory. However, the wide spread in average transit temperatures that were encountered provided valuable guides to the effect of setting the thermostats at various temperatures. In analyzing the data from these tests, we selected test packages shipped at average temperatures ranging from 65° to 69° F., 60° to 64°, 55° to 59°, and 50° to 54°. The data were separated for two maturities of fruit.

Early-season fruit shipped from the Sacramento River district between July 11 and 13 had initial pressures of 20 pounds or slightly more (fig. 9). When such fruit was shipped at average transit temperatures in the range of 65° to 69° F., it arrived in New York with average pressures of 10.4 pounds. Such fruit required only 2 days to reach an eating-ripe stage, and slightly over 1 day to reach the color break. When transit temperatures were in the 60° to 64° range, the firmness on arrival was 18 pounds; the fruit took 4 days to reach an eating-ripe stage and slightly over 2 days to reach the color break. In the 55° to 59° range the average firmness on arrival was 20.3 pounds; the fruit



1/ SACRAMENTO RIVER DISTRICT FRUIT WITH INITIAL PRESSURES OVER 20 LB., SHIPPED JULY 11-13, 1961, TO NEW YORK, N.Y.

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Figure 9.--Effect of transit temperatures on ripening of early-season Bartlett pears shipped, July 11-13, 1961, from the Sacramento River District of California to New York, N. Y.

required about 4-1/2 days to reach an eating-ripe stage and slightly less than 3 days to reach the color break. In the 50° to 54° range the average firmness on arrival was 22.6 pounds; 6 days were required to ripen the fruit and 5 days to reach the color break. A slight increase in firmness is common in fruit shipped at this temperature range.

It appeared, then, that average temperatures near 60° F. would be safe for fruit of this maturity. To obtain such average temperatures in transit, one would have to consider the initial fruit temperature and the time required to cool the fruit in transit. If the fruit was below 75° initially, a thermostat setting of 60° would probably be adequate.

Fruit shipped slightly later in the season, July 19 to 20, had average initial pressures of 18 to 19 pounds (fig. 10). When average transit temperatures ranged from 65° to 69° F., such fruit softened to 5.3 pounds by the time it arrived in New York. It reached an eating-ripe stage in 2 days and the color break in less than 1 day. When transit temperatures were in the 60° to 64° range, the arrival pressure was 8.3 pounds; the fruit reached an eating-ripe stage in 3 days and the color break in 2 days.

When the range was 55° to 59°, the firmness on arrival was 17.3 pounds; the fruit reached an eating-ripe stage in slightly over 3 days and the color break in about 2-1/2 days. In the 50° to 54° range, firmness on arrival was about equal to that at time of packing, and about 4 days was required to ripen the fruit. The color break was reached in 3-1/2 days.

Fruit of this maturity, therefore, should be held at average transit temperatures near 55° F. Fruit that was initially below 75° probably would have an average transit temperature close enough to 55° if the thermostat were set at 55°. If initial temperatures were warmer, the thermostat should be set at about 50°.

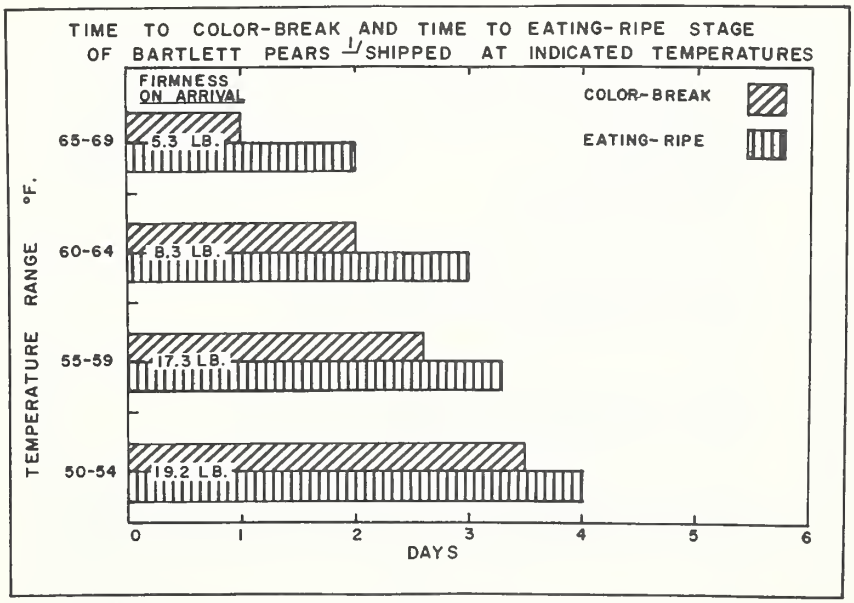

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Figure 10.--Effect of transit temperatures on ripening of mid-season Bartlett pears shipped, July 19-20, 1961, from the Sacramento River District of California to New York, N. Y.

We do not have data on fruit shipped at lower pressures than these two examples, but for such fruit, it would probably be best to set the thermostat near 35° for maximum refrigeration. By this stage of the season, the shippers or buyers would have less incentive to hasten ripening than with early-season fruit.

Table 3 shows recommended protective services and thermostat settings for early-season fruit. The table is based on research conducted in the 1959, 1960, and 1961 seasons.[3]

TABLE 3.--Recommended protective refrigeration services for early-crop California Bartlett pears shipped to New York[1]

Average initial pressure of pears	Initial temperature of pears	Standard ice cars			Thermostat setting in mechanical and Ice Tempco cars
		Protective service	Re-icing stations[2]		
			First	Second	
	°F.				°F.
Above 19 lb.	Below 75	Pre-ice to half-stage capacity, replenish, and re-ice once in transit (Rule 254a).[3]	Chicago (IC, CMStP&P, C&NW) or Decatur, Ill. (WAB) or Peoria, Ill. (TP&W)		60
	75 to 85	Pre-ice to half-stage capacity, replenish, and re-ice twice in transit (Rule 254b).	Council Bluffs, Iowa (UP) or Lincoln, Nebr. (CB&Q) or Kansas City, Mo. (UP, WAB)	Marion, Ohio (EL) or Columbus, Ohio (Penn) or Cleveland, Ohio (NYC)	55
	Above 85	Pre-ice to half-stage capacity, replenish, and re-ice twice in transit (Rule 254b).	Ogden, Utah (SP, UP) or Salt Lake City (WP)	Chicago (IC, CMStP&P C&NW) or Decatur, Ill. (WAB) or Peoria, Ill. (TP&W)	55
18 to 19 lb.	Below 75	Pre-ice to half-stage capacity, replenish, and re-ice twice in transit (Rule 254b).	Council Bluffs, Iowa (UP) or Lincoln, Nebr. (CB&Q) or Kansas City (UP, WAB)	Marion, Ohio (EL) or Columbus, Ohio (Penn) or Cleveland, Ohio (NYC)	55
	75 to 80	Pre-ice to half-stage capacity, replenish, and re-ice twice in transit (Rule 254b).	Ogden, Utah (SP, UP) or Salt Lake City (WP)	Chicago (IC, CMStP&P, C&NW) or Decatur, Ill. (WAB) or Peoria, Ill. (TP&W)	50
	Above 80	Pre-ice to half-stage capacity, Standard Refrigeration (Rule 200).	All regular re-icing stations		50
17 to 18 lb.	Below 75	Pre-ice to half-stage capacity, Standard Refrigeration (Rule 200).	All regular re-icing stations		35
	Above 75	(1) Precool in car pre-iced to full-bunker capacity, Standard Refrigeration (Rule 200).	All regular re-icing stations		35
		or			
		(2) Precool below 55° F. before loading and ship in car pre-iced to half-stage capacity, replenish, and re-ice twice in transit (Rule 254b).	Council Bluffs, Iowa (UP) or Lincoln, Nebr. (CB&Q) or Kansas City (UP, WAB)	Marion, Ohio (EL) or Columbus, Ohio (Penn) or Cleveland, Ohio (NYC)	35

[1] Recommended services are for immediate marketing of early fruit; if fruit is to be stored on arrival, protective services should be altered.
[2] Equivalent icing stations should be used on other routes.
[3] Rule 254a, 254b, and 200 are from Perishable Protective Tariff No. 18.

In principle, the Ice Tempco car is sound, and with some modifications the car would be useful to pear shippers who wish to control ripening in transit. Setting a thermostat to obtain desired transit temperatures would be simpler than trying to judge the correct icing schedule. The Ice Tempco car would also be useful to shippers who do not have precooling facilities at shipping point, since temperature reduction during transit is more rapid than in a regular ice car or in a mechanically refrigerated car.

Experience in the 1961 season indicates that the following modifications in the car are needed: (1) A ceiling duct to carry the air to the "A" end of the car and provide more uniform temperatures; (2) better calibration of the thermostats; and (3) spacers at the "A" end of the car to allow refrigerated air to reach fruit in the lower layers at that end of the load.

[3] Harvey, John M., Uota, M., Ringel, S. M., and Smith, M. A. Modified Protective Services for Shipment of California Bartlett Pears--Tests in 1960 Season. U. S. Dept. Agr. Mktg. Res. Rpt. 475, 19 pp., illus. May 1961.

Harvey, John M., Uota, M., Ringel, S. M., and Cook, F. L. Studies of Modified Protective Services for Rail Shipments of Bartlett Pears, 1959 Season. U. S. Dept. Agr. AMS-385, 12 pp., illus. June 1960.

Data collected in the 1961 season also provide a basis for setting thermostats in accordance with fruit maturity and initial temperature. The feasibility of modified icing for early fruit has also been reaffirmed in this year's tests.

APPENDIX

The following charts give results of additional test shipments with Bartlett pears in Ice Tempco cars.

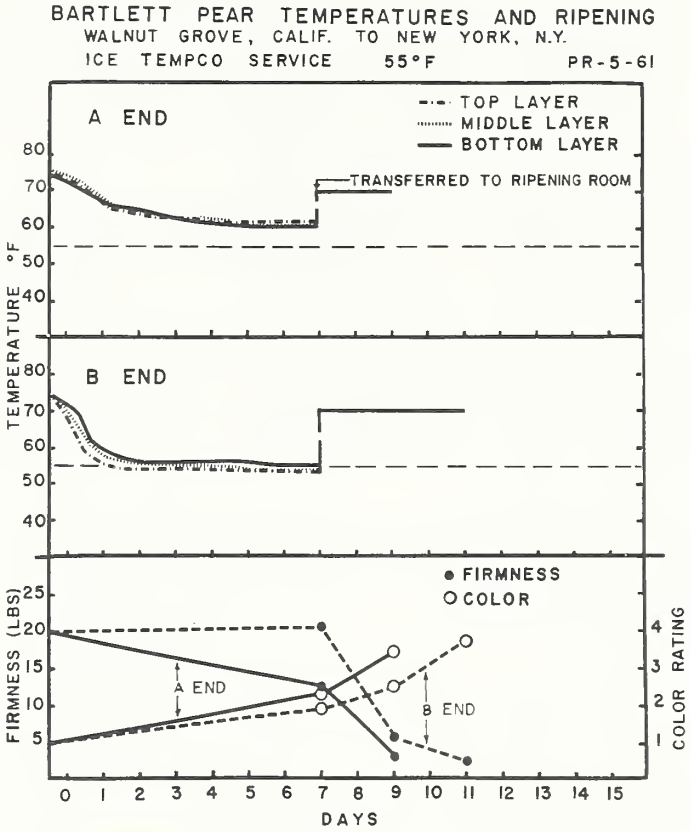

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Figure 11. --(Test Pr-5) Transit temperatures and color ratings of early-season Bartlett pears shipped July 13, 1961, from the Sacramento River District of California to New York, N. Y.

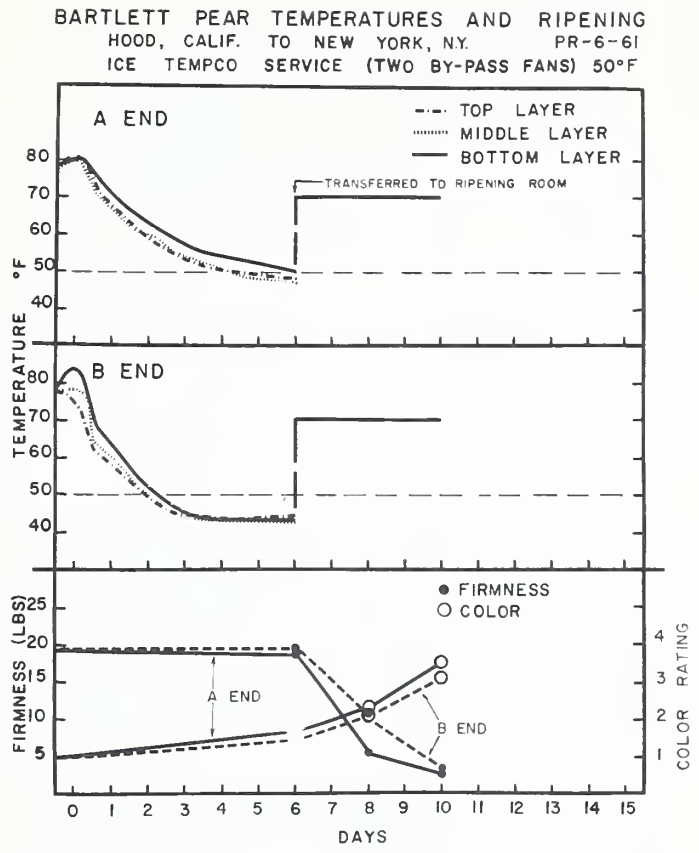

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Figure 12.--(Test Pr-6) Transit temperatures and color ratings of early-season Bartlett pears shipped July 19, 1961, from the Sacramento River District of California to New York, N. Y.

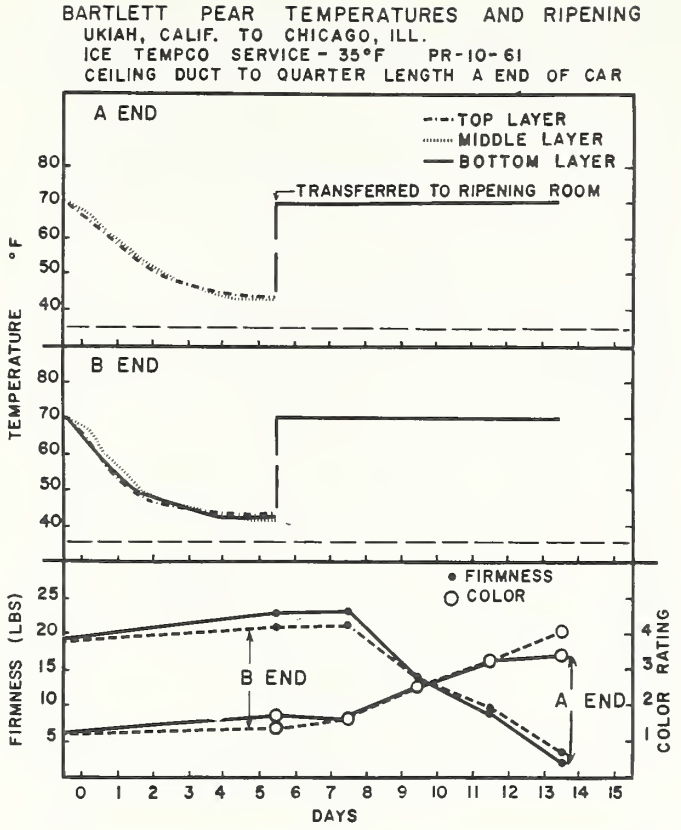

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Figure 13. --(Test Pr-10) Transit temperatures and color ratings of mid-season Bartlett pears shipped August 15, 1961, from Mendocino County, Calif., to Chicago, Ill.

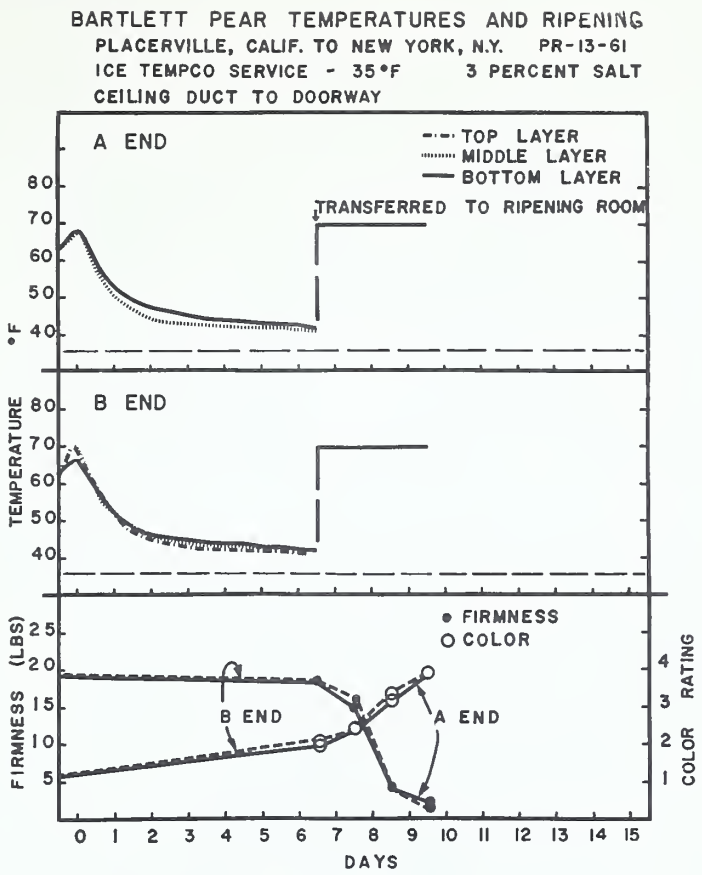

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Figure 14. --(Test Pr-13) Transit temperatures and color ratings of mid-season Bartlett pears shipped August 23, 1961, from the Placerville District of California to New York, N. Y.

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